Electric probe measurements in the scrape-off layer of ASDEX Upgrade and inside the last closed flux surface

ASDEX Upgrade Team

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Electric probe measurements in the scrape-off layer of ASDEX Upgrade and inside the last closed flux surface

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In ASDEX Upgrade (AUG) a graphite probe head (the so-called "Innsbruck probe") is being used for several years with very good results. Its construction is described in detail in [1]. The probe head carries six graphite probe pins of 1 mm diameter and 2 mm length each. One of the pins is mounted 3 mm protruding thus measuring on a lower radial position than the other probe pins (i.e. the pin is deeper in the plasma). Recently in several L-mode discharges the probe head was inserted into the AUG edge plasma region even beyond the shear layer. The shear layer is characterised by a sudden change of the direction of the poloidal rotation and is considered a good measure of the position of the separatrix and the last closed flux surface (LCFS). Our results demonstrate that we penetrated 4 mm into the plasma beyond the LCFS. Fig. 1 shows a schematic of the front side of the probe head and the biasing of the pins in this case. The radial and poloidal electric field components were derived, using the floating potentials of probe pins 6, 8 and 11. Obviously for this method, we have to assume that the electron temperature and in particular the fluctuations are equal on all three pin positions. Pin 7 or 10 were biased negatively yielding the plasma density. The change of poloidal rotation was determined from the cross correlation, once of the two above mentioned ion saturations and once of the floating potentials of the pins 8 and 11. Similar results were obtained in both cases. From the temporal delay between $I_{sat,7}$ and $I_{sat,10}$ also the speed of the poloidal rotation was determined. The deep insertion of the probe head beyond the LCFS, which was not risked before, caused a visible sputtering of the probe pins, by making them "sharper". However, they are still useable. In contrast to other recent results [2,3], no heating of the pins to electron emission was observed.

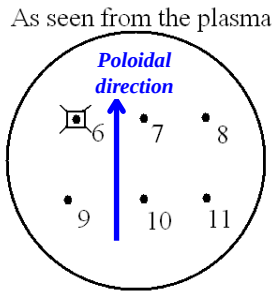

Fig. 1: Front side of "Innsbruck" probe head with six probe pins: pin 6 (3 mm protruding radially) – floating, 7 – biased for I_{sat}, 8 – floating, 9 – swept, 10 – I_{sat}, 11 – floating. The toroidal/ poloidal distances between the pins are 10 mm.

Nevertheless, this method flaws from the use of the cold floating potentials for the determination of the electric fields and probes featuring directmeasurements of the plasma potential would be highly preferable. Supplementing to the ball-pen probe (BPP) [3], the floating potential of which is equal to the plasma potential, we have designed emissive probes for a constructing a new probe head for AUG and other mid size devices containing three emissive probes, which for the measurements of the plasma potential. In this design mono-crystalline electron sources, used for electron microscopes are envisaged as the emissive probes.

References

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